TABLE 1.—*Monthly and annual precipitation*—Continued.

POST, CROOK COUNTY.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l.
1908	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.43	.....
1909	2.23	1.36	0.78	0.12	0.92	0.85	0.68	0.00	1.06	0.85	2.27	0.91	12.03

WARMSPRING, CROOK COUNTY (latitude, 44° 46′ N; longitude, 121° 35′ W; elevation, 1,600 feet.)

1902	.....	.....	.....	.....	0.55	0.04	0.47	0.11	0.01	0.30	1.02	2.34	.....
1903	2.37	0.27	0.80	0.26	0.23	0.65	0.10	0.21	0.04	0.38	3.09	0.23	8.63
1904	0.50	3.08	3.46	1.88	0.37	0.06	2.35	1.95	0.28	0.85	0.27	1.21	16.26
1905	2.01	0.59	0.92	0.42	1.27	0.77	0.53	T.	1.40	1.16	0.17	0.68	9.92
1906	1.25	1.02	2.21	0.23	0.77	1.36	0.36	0.00	0.14	T.	0.98	1.07	9.39
1907	3.31	2.83	1.59	0.70	0.83	0.49	0.38	0.66	0.12	0.20	0.74	4.33	16.18
1908	0.36	0.43	1.53*	0.20	0.93	0.40	0.75	0.60	0.43	1.68	0.81	0.40	8.52
1909	3.12	0.94	0.21	0.00	0.74	0.87	0.22	0.00	1.15	0.62	2.96	1.93	12.76
Mns.	1.85	1.31	1.53	0.53	0.71	0.58	0.64	0.44	0.45	0.65	1.26	1.52	11.47

* Interpolated.

TABLE 2.—*Mean temperature.*

Stations.	Length of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Bend	8	30.9	34.0	36.8	43.4	49.0	55.2	62.7	62.1	53.7	49.3	29.2	31.9	44.8
Grass Valley	7	28.8	33.5	40.4	45.2	49.5	56.1	64.0	62.1	55.4	48.2	38.9	31.2	46.1
Heisler	3	32.9	38.7	42.6	49.9	54.0	61.1	71.9	66.0	60.5	50.5	40.0	38.0	50.5
Prineville	12	33.2	36.1	40.5	46.5	53.1	58.2	64.8	63.3	57.0	49.9	41.7	36.0	48.4
Silver Lake	15	28.3	31.4	35.7	42.8	48.8	55.6	64.6	60.9	53.6	45.2	36.8	29.8	44.5
The Dalles	34	32.6	34.2	46.0	53.5	60.6	66.4	72.6	70.8	62.6	52.3	42.2	36.0	52.5
Wamic	6	32.1	24.8	40.7	48.0	52.4	59.7	66.3	64.1	58.3	51.0	41.3	32.1	47.6
Warmspring	8	32.8	37.3	42.8	49.9	54.9	62.2	69.9	68.7	60.9	51.7	42.0	33.8	50.6

TABLE 3.—*Highest temperatures by months.*

Stations.	Length of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Bend	8	59	66	72	84	93	93	102	98	92	86	69	61	102
Grass Valley	8	58	66	70	82	90	91	106	99	98	85	72	56	106
Heisler	4	58	67	72	92	89	99	105	100	97	88	71	63	105
Prineville	13	76	73	83	92	96	98	105	99	93	89	82	76	105
Silver Lake	15	69	70	73	86	94	94	104	101	95	91	77	66	104
The Dalles	35	65	69	78	88	98	103	105	108	101	88	73	66	108
Wamic	8	64	69	72	84	89	98	105	112	97	85	81	56	112
Warmspring	8	69	68	72	90	94	101	109	105	97	90	75	63	109

TABLE 4.—*Frost data.*

Stations.	Length of record.	Average date of first killing frost in autumn.	Average date of last killing frost in spring.	Earliest date of killing frost in autumn.	Latest date of killing frost in spring.
Bend	.....	September 2...	January 8.....	August 14.....	January 27
Crescent	.....	.....	.....	.....	.....
Grass Valley	7	September 21..	May 20.....	August 11.....	January 13
Heisler	3	October 1.....	May 3.....	September 11..	May 17
Prineville	13	September 17..	May 28.....	August 18.....	June 26
Silver Lake	13	August 23.....	January 16....	July 17.....	January 30
Sisters	.....	.....	.....	.....	.....
The Dalles*	34	November 5...	April 10.....	September 26..	May 12
Wamic	7	October 12.....	May 1.....	September 23..	May 20
Warmspring	7	September 2...	May 16.....	September 11..	June 14

*Temperature of 32°, or below, used.

NOTE.—In cases where the records do not show actual frost temperatures of 26° or below have been used, as this temperature appears to be the critical one for the staple crops in the bottom lands, and hardy vegetation does not suffer greatly unless the temperature reaches 26° or goes below that mark.

The above table should not be used for comparison of frost data with similar data from other sections of the country where a temperature of 32° has been used as a limiting basis for determining the occurrence of frost, instead of 26°, as indicated above.

TABLE 5.—*Lowest temperatures by months.*

Stations.	Length of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Bend	8	−19	−19	−13	8	11	22	28	26	12	14	− 4	−11	−19
Grass Valley	8	−30	−17	− 4	16	11	25	31	28	20	15	7	1	−30
Heisler	4	−19	6	0	16	23	27	40	29	28	15	13	11	−19
Prineville	13	−29	−17	− 1	12	21	23	29	28	17	13	5	− 5	−29
Silver Lake	15	−28	−30	−20	8	14	13	25	30	13	9	−32	−16	−32
The Dalles	35	−19	−19	− 1	25	30	39	42	41	31	20	− 2	−18	−19
Wamic	8	−25	−19	− 3	18	25	29	32	28	19	21	11	− 4	−25
Warmspring	8	−32	− 4	8	18	25	26	35	35	23	17	9	− 8	−32

TABLE 6.—*Average number of days with .01 inch or more of precipitation.*

Stations.	Length of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Bend	7	10	8	9	4	5	5	3	2	4	4	8	8	70
Crescent	4	12	12	12	6	8	6	5	2	4	6	8	12	93
Grass Valley	8	6	4	5	2	4	4	2	2	2	4	7	7	49
Heisler	3	7	6	9	4	6	6	4	2	2	2	4	9	61
Prineville	13	4	5	6	3	4	4	2	3	3	3	4	4	44
Silver Lake	14	4	5	5	6	5	4	3	2	3	6	5	5	67
Sisters	2	16	10	6	1	5	5	4	4	6	8	10	9	86
The Dalles	35	11	9	9	5	4	4	1	1	4	3	10	12	73
Wamic	8	10	7	7	3	3	3	1	2	2	4	9	7	66
Warmspring	8	8	8	11	5	5	5	4	2	3	4	7	8	70

TABLE 7.—*Average depth of snowfall.*

Stations.	Length of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Bend	7	13.5	9.0	8.0	1.2	0.3	0.0	0.0	0.0	0.0	0.0	3.1	10.8	45.9
Crescent	4	22.2	7.8	2.1	1.8	0.0	0.0	0.0	0.0	0.0	0.0	T.	18.5	52.4
Grass Valley	8	8.2	2.2	2.4	T.	T.	0.0	0.0	0.0	0.0	T.	2.1	6.4	21.3
Heisler	3	3.0	6.2	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	T.	1.2	11.8
Prineville	13	3.3	5.8	2.6	T.	T.	T.	0.0	0.0	0.0	T.	0.7	0.8	13.2
Silver Lake	14	5.7	5.9	4.4	3.2	0.4	T.	0.0	0.0	0.0	0.3	2.4	5.9	28.2
Sisters	2	.....	10.6	4.0	0.1	0.0	0.2	0.0	0.0	0.0	0.0	2.2	17.2	.....
The Dalles	35	13.2	8.0	1.1	T.	0.0	0.0	0.0	0.0	0.0	T.	2.1	11.5	3.0
Wamic	8	14.9	13.5	6.8	0.2	0.0	0.0	0.0	0.0	0.0	0.1	6.2	14.4	56.1
Warmspring	8	9.7	5.1	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	5.8	24.2

TABLE 8.—*Direction of prevailing wind.*

Stations.	Length of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Bend	6	sw.	sw.	sw.	sw.	nw.	sw.	n.	sw.	sw.	sw.	sw.	sw.	sw.
Crescent	4	s.	s.	s.	s.	sw.	nw.	s.	sw.	sw.	n.	n.	s.	s.
Grass Valley	8	sw.	sw.	sw.	nw.	nw.	sw.	nw.	nw.	nw.	sw.	sw.	sw.	sw.
Heisler	4	s.	w.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	sw.	nw.
Prineville	7	sw.	sw.	sw.	sw.	nw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.
Silver Lake	15	sw.	sw.	sw.	sw.	sw.	sw.	sw.	w.	w.	sw.	sw.	sw.	sw.
Sisters	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
The Dalles	35	e.	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.	e.	w.
Wamic	8	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.
Warmspring	8	sw.	sw.	ne.	sw.	w.	w.	nw.	nw.	nw.	nw.	sw.	nw.	nw.

WATER RESOURCES OF DESCHUTES RIVER DRAINAGE BASIN.

By J. C. STEVENS, District Engineer, United States Geological Survey.

Deschutes River has its source in a number of mountain lakes at the summit of the Cascades, just over the mountains from the headwaters of Willamette River, and its course is northward to the Columbia, which it enters about 15 miles above The Dalles.

The principal tributaries of Deschutes River are White, Warmsprings, Metolius, and Crooked rivers, and the West Fork of the Deschutes. All except Crooked River drain the eastern slope of the Cascades, which contributes the larger portion of the stream flow. The drainage area of the system is distributed somewhat as follows:

	Sq. miles.
Deschutes at Bend	1,530
Deschutes above the mouth of the Crooked River	2,520
Deschutes at Sherars Bridge	8,750
Deschutes River above Lava post-office (locally known as Little River)	720
Crooked River	2,920
East Fork of Deschutes River	200
West Fork of Deschutes River	500

Topographically, the area is rough and mountainous. The agricultural lands consist largely of high table lands cut by deep canyons through which the rivers flow, and small arable areas which border the streams. The soil is a coarse, disintegrated lava. The rocks of the entire area are volcanic and so peculiarly porous that the basin has an effect similar to that of a huge sponge. Deschutes River has perhaps the most remarkably uniform flow of any river comparable with it in size, and on this account its economic value is very great. At the mouth of the stream the maximum flow is six times, and at Bend only three times, the minimum. Ocular evidence of this uniformity of flow is presented by the low grass-grown banks between which the river flows throughout its upper course.

The general elevation of the lands around Bend is 3,600 feet above sea level; that of the summit of the Cascade Mountains is 5,000 to 6,000 feet. Prineville is 2,868 feet above sea level, and Paulina, near the upper portion of the Crooked River drainage basin, 3,684 feet.

The timbered portions of this drainage basin are found on the eastern slope of the Cascades, and at the headwaters of Crooked River. These areas constitute about 30 per cent of the total drainage area.

Although the winter temperatures are low, ice conditions do not effect the determination of stream flow to any extent. This is due to the fact that the waters reach the river in the form of springs. The high stages usually occur in July, and result from the melting of snow in the mountains, although occasionally floods are caused by chinooks in early spring or late fall.

WATER SUPPLY.

The investigations of stream flow by the United States Geological Survey in this drainage area began in 1903. The territory has been somewhat inaccessible, and it has not been possible to maintain as many gaging stations as the development of the country requires. Only the flow at critical points has been determined, without any specific studies of the manner in which the water supply is contributed by the several units of the drainage basin. The results of these are summarized in the accompanying tables. More specific information can be obtained by consulting the original reports of the United States Geological Survey. The data for 1903 are contained in Water Supply Paper No. 100, 1904 in No. 135, 1905 in No. 178, 1906 in No. 214, and 1907–8 in No. 252, where special descriptions of stations are given, and more detailed information as to the discharges and the conditions under which they were obtained.

Estimated monthly discharge of East Fork of Deschutes River at Crescent. (Drainage area, 196 square miles.)

	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1905.				
January	131	60	76.6	4,710
February	104	41	74.0	4,110
March	92	60	64.7	3,978
April	81	60	65.4	3,892
May	92	70	74.7	4,593
June	76	46	62.8	3,737
July	76	19	35.1	2,158
August	36	25	28.0	1,722
September	31	25	25.5	1,517
October	41	28	31.9	1,962
November	41	10	23.6	1,404
December	104	10	45.6	2,804
The year	131	10	50.7	36,590
1906.				
January	146	29	88.8	5,460
February	146	72	97.6	5,420
March	110	60	80.8	4,970
April	140	49	89.7	5,340
May	174	81	124.0	7,620
June	146	90	110.0	6,540
July	100	42	65.2	4,010
August	49	30	37.8	2,320
September	49	30	36.3	2,150
October	60	30	35.4	2,180
November	77	30	52.0	3,090
December	68	42	52.0	3,200
The year	174	29	73.0	52,300
1907.				
January	174	64	89.7	5,520
February	395	110	183.0	10,200
March	174	90	104.0	6,400
April	245	81	184.0	10,900
May	245	146	195.0	12,000
June	216	90	151.0	8,980
July	110	49	76.5	4,700
August	56	42	47.5	2,920
September	42	42	42.0	2,500
October	42	33	35.5	2,180
November	52	33	35.2	2 090
December	160	33	68.9	4,240
The year	395	33	101.0	72,600
1908.				
January	81	46	58.1	3,570
February	100	52	70.8	4,070
March	100	36	60.9	3,740

Estimated monthly discharge of Deschutes River (Little River) at Allen's ranch near Lava, Oreg.

	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1905.				
February 17–28	368	262	306	7,283
March	382	283	319	19,620
April	317	242	274	16,300
May	317	252	278	17,090
June	294	205	241	14,340
July	196	115	141	8,670
August	125	93	107	6,579
September	97	89	90.9	5,409
October	115	97	100	6,149
November	102	79	90.6	5,391
December	115	82	99.2	6,100
The period				112,900
1906.				
January	223	120	166	10,200
February	160	97	123	6,830
March	180	106	136	8,360
April	544	147	332	19,800
May	559	329	445	27,400
June	483	294	369	22,000
July	294	141	220	13,500
August	135	106	122	7,500
September	120	102	108	6,430
October	115	97	103	6,330
November	188	89	137	8,150
December	205	115	144	8,850
The year	559	89	200	145,000
1907.				
January	329	115	220	13,500
February	1,890	329	793	44,000
March	513	242	345	21,200
April	770	294	570	33,900
May	810	608	696	42,800
June	676	410	558	33,200
July	410	252	330	20,300
August	252	205	227	14,000
September	223	173	196	11,700
October	173	154	161	9,900
November	188	141	157	9,340
December	624	160	287	17,600
The year	1,890	115	378	271,000
1908.				
January			*b*	18,400
February			*b*	9,780
March	485	154	271	16,700
April	687	223	407	24,200
May	592	283	416	25,600
June	452	263	339	20,200
July	294	180	254	15,600
August	166	125	139	8,550
September	242	120	141	8,390
October	340	115	174	10,700
November	262	154	180	10,700
December	214	160	180	11,100
The period	687	115	248	180,000

b Estimated.

Under present market conditions for water power, the value of a river for this purpose is governed largely by the volume of water it carries at its minimum stage. A river, therefore, of the size of Deschutes, with the unusual uniformity of flow that obtains, has an immense value as an industrial factor. The following table used in conjunction with the discharge data given above furnishes the basis for an estimate of the water power possibilities of this stream.

Profile of Deschutes River.

	Elevation	Fall between points.	Distance between points.	Fall per mile.
	Feet.	*Feet.*	*Miles.*	*Feet.*
Crescent Lake	5000			
Mouth of East Fork	4440	560	21.5	26.1
Rosland	4210	230	15.8	14.5
Bend	3650	500	20.0	25.0
Cline Falls	2760	890	18.0	49.2
Mouth of Crooked River	1960	800	26.5	30.2
Mouth of Trout Creek	1155	805	25.5	31.5
Sherar's Bridge	690	465	40.5	11.4
Government Dam site	395	295	21.5	13.7
Mouth	156	239	19.5	12.3

From these data the total available power in the Deschutes River and its principal tributaries at the average low-water stage is found to be 1,115,000 horsepower. This assumes that

90 per cent of the fall can be utilized, and 80 per cent of theoretical power realized on water wheels. The two railroad lines now under construction in the lower 80 miles of the river's course will reduce this power somewhat, but both roads have elevated their tracks to permit the construction of three dams, one at the mouth of the river known as Moody's Dam, one at the Government Dam site 19½ miles above the mouth, and one at Sherar's Bridge 40 miles above the mouth. The ultimate development contemplated at these three power sites aggregate 139,000 horsepower. Beyond Sherar's Bridge the railroads follow the grade of the river very closely to the vicinity of Trout Creek, where both lines leave the river. After these railroads are completed, it will still be possible to develop on Deschutes River a total of 924,200 horsepower. Irrigation development in the upper portion of the river will still further reduce the water that can be used for power purposes. It has been estimated that when the irrigation requirements are satisfied, the total possibilities for power development in Deschutes River will still reach the enormous sum of 550,000 horsepower. After storage reservoirs, proposed and under construction, are completed, the available supply for power development will increase this about 100,000 horsepower, so that after the construction of all roads, development of all irrigation projects, and the construction of all reservoirs, the river will be capable of developing 650,000 horsepower. This is nearly four times the total amount of water power developed at the present time in the States of Oregon, Washington, and Idaho, combined.

Estimated monthly discharge of West Fork of Deschutes River (Big River) near Lava, Oreg., for 1905.

	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1905.				
February 20–28	1,148	1,123	1,135	20,260
March	1,168	1,103	1,142	70,220
April	1,123	1,074	1,083	64,440
May	1,098	1,074	1,081	66,470
June	1,074	1,038	1,050	62,480
July	1,027	994	1,007	61,920
August	984	984	984	60,500
September	994	944	961	57,180
October	984	942	958	58,900
November	932	902	920	54,740
December	942	875	895	55,030
The period				632,100

Estimated monthly discharge of Deschutes River at West's ranch near Lava post-office, Oreg. (Drainage area, 1240 square miles.)

	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1906.				
July 21–31	1,510	1,430	1,470	32,100
August	1,430	1,360	1,410	86,700
September	1,400	1,360	1,370	81,500
October	1,360	1,290	1,320	81,200
November	1,510	1,290	1,370	81,500
December	1,510	1,320	1,390	85,500
The period				448,000
1907.				
January	1,610	1,160	1,390	85,500
February	4,000	1,520	2,300	128,000
March	2,060	1,610	1,750	108,000
April	2,500	1,630	2,170	129,000
May	2,680	2,430	2,510	154,000
June	2,540	2,120	2,350	140,000
July	2,120	1,900	2,020	124,000
August	1,900	1,800	1,860	114,000
September	1,850	1,700	1,770	105,000
October	1,700	1,590	1,630	100,000
November	1,700	1,520	1,580	94,000
December	2,560	1,480	1,770	109,000
The year	4,000	1,160	1,920	1,390,000
1908.				
January	2,060	1,390	1,700	105,000
February	1,520	1,280	1,440	82,800
March	1,960	1,350	1,600	98,400
April	2,230	1,569	1,880	112,000
May	2,120	1,850	2,030	125,000
June	2,180	1,850	2,000	119,000
July	2,010	1,750	1,890	116,000
August	1,750	1,660	1,680	103,000
September	1,660	1,560	1,620	96,400
October	1,900	1,560	1,660	102,000
November	1,700	1,520	1,570	93,400
December	1,520	1,170	1,430	87,900
The year	2,230	1,170	1,710	1,240,000

Estimated monthly discharge of Deschutes River at Moro (now Biggs) post-office, Oreg. (Drainage area, 9,180 square miles).

	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1898.				
January	8,200	5,960	6,610	406,433
February	10,720	6,240	7,880	437,633
March	8,200	5,750	6,924	425,740
April	8,760	5,750	7,502	446,400
May	7,640	6,520	7,071	434,779
June	7,360	5,750	6,450	383,802
July	6,520	5,415	5,622	345,683
August	5,500	5,330	5,388	331,295
September	5,415	5,265	5,346	318,109
October	5,330	5,265	5,278	324,532
November	7,080	5,265	5,635	335,306
December	5,625	5,050	5,324	327,360
The year	10,720	5,050	6,253	4,517,072
1899.				
January	11,560	5,100	6,881	423,096
February	14,080	5,200	7,624	423,415
March	15,480	6,520	7,920	486,492
April	13,800	7,640	10,832	644,549
May	12,400	8,760	10,440	641,931
June	11,280	9,600	10,543	627,352
July	9,600	7,080	8,570	526,949
August	7,080	5,960	6,628	407,540
September	7,080	5,625	6,263	372,674
October	8,760	5,625	6,265	385,220
November	11,560	6,240	7,127	424,086
December	11,560	8,760	9,907	609,158
The year	15,480	5,100	8,250	5,972,952
1906.				
July 22-31	5,370	5,370	5,370	106,000
August	? 5,370	5,370	5,370	330,000
September	5,140	5,140	5,140	306,000
October	5,740	5,140	5,220	321,000
November	9,500	5,260	6,640	395,000
December	8,000	5,720	6,360	39,100
The period				1,850,000
1907.				
January	11,900	6,000	6,780	417,000
February	30,600	7,120	14,100	783,000
March	15,800	7,620	9,760	600,000
April	14,500	8,160	12,100	720,000
May	10,800	8,200	9,090	559,000
June	8,100	6,750	7,330	436,000
July	6,750	5,700	6,290	387,000
August	5,850	5,700	5 710	351,000
September	5,700	5,700	5,700	339,000
October	5,700	5,700	5,700	350,000
November	7,900	5,700	6,020	358,000
December	22,200	6,110	8,800	541,000
The year	30,600	5,700	8,120	5,840,000
1908.				
January	8,100	6,190	7,500	461,000
February	6,190	6,000	6,100	351,000
March (a)	16,000		8,700	535,000
April	10,300	7,500	8,630	514,000
May	8,520	6,940	7,430	457,000
June (a)			6,500	387,000
July (a)			6,000	369,000
August (a)			5,400	332,000
September (a)			5 400	321 000
October (a)			5,400	332,000
November (b)	6,000	5,940	5,990	356,000
December	5,980	5,550	5,750	354,000
The period	16,000		6,570	4,770,000

IRRIGATION.

The lands bordering the east side of Deschutes River above Crooked River are susceptible of irrigation. There are also large areas of agricultural lands along the western bank of the river below Tumalo Creek, in the vicinity of Squaw Creek, and on the Indian Reservation. The irrigation of these lands lies beyond the resources of individual effort, and must be developed by the State or by the Government, or by community or corporate investment. The water supply is ample, the land is rich, and the climate favorable for agricultural pursuits.

There has been segregated in this valley for development under the provisions of the Carey Act nearly 360,000 acres of land; of

this amount about 30,000 acres have actually been irrigated. The largest canals in operation are those of the Deschutes Irrigation and Power Company which divert water from the right bank of Deschutes River, a short distance above Bend. These canals have a common headgate, and are known as the Pilot Butte and Central Oregon canals. The maximum combined discharge of these two diversions has been about 600 second-feet. A number of other segregations have been made for reclamation under the terms of the Carey Act, and some ditches have been constructed and are in operation. The Columbia Southern Irrigating Company diverts water from Tumalo Creek: about 27,000 acres were segregated, but the water supply is insufficient for this entire area, although with the development of such storage facilities as the area affords they can doubtless all be irrigated from this stream.

FLOOD IN THE WILLAMETTE VALLEY IN FEBRUARY AND MARCH, 1910.

By H. J. ANDREE, Assistant Observer, Portland, Oreg.

This flood was caused by very heavy precipitation during the days immediately preceding the rise and the melting of snow on the western slopes of the Cascade Mountains, also in the lower portions of the river, by the high stage of the Columbia which was more than 9.0 feet above the normal during this time.

The Willamette, at Portland, was not at a low stage at any time during the month of March and averaged over 4.0 feet higher than during any March in the past 20 years. The stage of 19.6 feet on the 5th was higher than any recorded in March since the keeping of an official record.

The heaviest rains began on February 23 and continued through to March 4, with little interruption. During that time 18.0 inches fell along the northwest coast, about 5.0 inches in the Willamette Valley proper, and from 6.0 to 10.0 inches on the western slope of the Cascade Mountains. With the exception of that on the western side of the Coast Range, practically all the run-off flowed into the Willamette causing a rapid rise late in February and reaching the highest stage, 3.0 feet above flood stage, at Eugene on March 1, and 4.6 feet above the flood stage at Portland on the 5th. Besides the water from rains, there was more snow than usual at that time of year on the western slope of the Cascades and a large portion of it melted and added its volume to the already large amount in the Willamette Valley.

The water from these rains and melting snows flowed rather evenly into the main stream over its entire length and as a result there was no particular crest. Near the end of the month there was a second period of comparatively high water, due to more than the usual amount of precipitation from the 16th to the 23d, and the gage reading was 14.8 feet at 8:00 a. m. on the 26th at Portland. A few days after the second rise the river fell to below the normal stage at all stations except Portland, where, on account of the abnormal stage of the Columbia, the Willamette remained nearly 4.0 feet above the normal at the end of the month.

The loss caused by the flood was not great. As usual, the bottom lands were flooded. At Portland, where much damage would have been occasioned to property in warehouses and basements, those interested were notified of all stages long enough in advance to enable them to remove perishable goods.

The swift currents that frequently cause heavy losses to lumbermen and interfere with shipping near Portland, did not exist during this rise as they were checked by high water in the Columbia whose confluence with the Willamette is only a few miles below.

Warnings were issued regularly from the time of the beginning of the rise until the water had fallen to below the flood stage. The highest stage at Salem was predicted within 0.2 foot 24 hours in advance, and the crest at all stations was predicted to within a few tenths of the stage actually reached. The exception was at Portland where the forecast was 0.9 foot too low; this low forecast was due to the existence of conditions not previously experienced here, namely high water in the Columbia at the time of a spring freshet in the Willamette, and it was practically impossible to accurately estimate the stage resulting from the unusual conditions, so close to the confluence of the streams. So far as is known, no losses occurred on account of this forecast as all those having only about a foot margin were advised to move valuable goods.

Warnings were also issued for the second rise at Portland. On Wednesday, March 23, a bulletin was published on the daily weather map to the effect that the river would reach 15.0 feet at Portland on Saturday the 26th. At 8 a. m. of the 26th the gage reading was 14.8 and the river was still rising, but had begun to fall before evening.

The accompanying tables show the stages of the water at the several gaging stations and the dates and maximum stages of other floods.

Daily stages in the Willamette River freshet of February 27 to March 9, 1910, inclusive.

Date.	Eugene.	Harrisburg.	Albany.	Salem.	Wilsonville.	Portland.	Jefferson.	McMinnville.	Tualitan.	Estacada.
	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.
February 27 a. m.	7.8	5.9	12.4	12.5	21.8	10.7	6.7	26.2	.....	7.8
February 28 a. m.	8.6	6.4	12.4	12.5	22.4	11.5	8.0	27.0	.....	10.0
March 1, a. m.	11.7	8.3	13.8	14.4	22.6	12.4	10.6	28.0	.....	12.0
March 1, p. m.	13.0	10.2	14.8	15.3	23.1	13.5	13.6	28.1	.....	14.4
March 2, a. m.	12.0	10.3	16.6	18.1	24.6	15.3	15.0	28.0	11.4	14.5
March 2, p. m.	10.6	10.0	18.0	19.5	25.3	16.3	14.0	28.1	11.8	13.7
March 3, a. m.	10.0	9.2	20.0	20.8	27.6	17.5	11.9	27.3	12.3	12.6
March 3, p. m.	.....	8.8	20.0	20.7	27.9	18.0	10.6	26.9	12.5	11.9
March 4, a. m.	9.2	8.0	18.3	19.6	28.6	18.7	9.0	25.3	12.8	11.0
March 5, a. m.	8.2	7.2	16.0	16.3	24.0	19.6	8.0	21.4	.....	10.0
March 6, a. m.	7.6	6.5	12.7	13.1	22.2	19.3	7.0	16.4	.....	9.0
March 7, a. m.	7.2	5.8	10.0	11.0	20.4	18.1	6.0	12.8	.....	8.2
March 8, a. m.	6.6	5.1	9.4	9.2	19.0	16.1	5.4	10.7	.....	7.7
March 9, a. m.	6.4	4.5	8.4	8.0	15.1	14.2	5.4	9.1	.....	7.5

Stages reached in 29 Willamette River freshets at Portland, Oreg.

Year.	Date.	Stage.	Year.	Date.	Stage.
		Feet.			Feet.
1880..	January 9	15.8	1896..	December 15	15.2
1881..	January 16	21.4	1897..	December 14	15.1
1881..	February 7	23.6	1899..	January 22	14.2
1883..	February 3	16.6	1899..	December 2	15.0
1885..	January 9	15.8	1900..	January 17	16.7
1886..	February 4	17.1	1901..	January 17	20.9
1887..	February 1	15.8	1901..	February 19	14.7
1888..	February 1	16.6	1903..	January 28	19.2
1890..	February 6	28.4	1907..	January 3	14.9
1893..	December 4	18.7	1907..	February 8	22.5
1894..	January 18	19.5	1907..	December 28	17.3
1894..	March 19	18.0	1909..	January 22	20.5
1895..	January 14	15.9	1909..	November 26	22.3
1896..	January 23	20.5	1910..	March 5	19.6
1896..	November 19	20.2			

Figs. 1 and 2 show the distribution of the rainfall producing the flood and the stages of the river at several points in its course.